

Recurrence Rate of Lumbar Disc Herniation After Open Discectomy in Active Young Men

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Study Design. A retrospective clinical study.

Objective. To estimate the recurrence rate of lumbar disc herniation after open discectomy in active young men using survival analysis.

Summary of Background Data. There are few reports on the recurrence rate of lumbar disc herniation in young adults, even though this age group shows a higher incidence of disc herniation than the other age groups. In addition, most of the studies on the recurrence rate of disc herniation have reported percentages without regard to the effect of the time course.

Methods. Medical records were retrospectively reviewed and phone call surveys were undertaken for 241 patients aged from 20 to 39 who had undergone open discectomies over a period of 14 years. A diagnosis of recurrence was based on the development of new symptoms and magnetic resonance imaging showing compatible lesions in the same segment as the initial diagnosis. The recurrence rate was calculated using a survival analysis based on the Kaplan-Meier product-limit method and the log-rank test was used to evaluate the effect of patient age, level of occurrence, and type of herniated disc on the recurrence rate.

Results. The overall recurrence rate was 7.1% (17 patients) at a mean follow-up of 8.55 years, and the cumulative survival rate was 91.5% at a follow-up of 14 years. Survival analysis estimated a higher rate of recurrence at longer follow-up, although there was no recurrence after ninth year from the primary surgery. The recurrence rate was significantly higher for protruded discs compared with other types.

Conclusion. Survival analysis provides a more accurate estimation of true recurrence rate. Protruded discs are more likely to show recurrence than other types.

Key words: lumbar disc herniation, open discectomy, recurrence rate, survival analysis, active young men.
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Degenerative changes in intervertebral discs begin from the late teens after the completion of physical growth and development, during which posterior herniation of the nucleus pulposus can cause sciatica because of nerve root compression. Therefore, it is known that over half of

lumbar disc herniations occur in active individuals aged between 20 and 40 years.¹

Although various surgical options exist for lumbar disc herniation patients who do not respond to conservative treatment, open discectomy still remains a standard method and it has been reported to have diverse outcomes.^{2–7} Some patients complain of persistent or recurrent radiating pain after open or minimally invasive discectomy, which can be accompanied by recurrence of the disc herniation.

Previous reports on the recurrence rate of disc herniation after surgery includes some drawbacks; the use of simple percentages without considering the effect of time course nor the follow-up losses, mixed patient populations, different definitions of recurrence, and a lack of precise radiologic criteria.^{8–13} We believe that these rough estimations cannot reflect a true recurrence rate of disc herniation and the use of survival analysis may be more appropriate in such studies to provide an accurate assessment. In addition, few reports have been published on the recurrence rate after open discectomy in young adult patients.

The present study analyzed the recurrence rate of lumbar disc herniation after open discectomy in active young men using survival analysis and investigated the effect of clinical factors such as patient age at operation, level, and type of primary disc herniation on recurrence.

■ Materials and Methods

Two hundred forty-one patients who had undergone conventional open discectomies for lumbar disc herniation between January 1992 and September 2005 were included in this study. All patients had disc herniations at a single level and had no other spinal conditions such as spondylolisthesis, spondylosis, spinal stenosis, or spinal instability. They were all male police or soldiers between 20 and 39 years of age who were engaged in vigorous work-related physical activities and training.

Hospital records and imaging studies including magnetic resonance imaging (MRI) of all patients were retrospectively reviewed. The most recent follow-up involved telephone call surveys to determine whether any new symptoms had developed. In all patients with any new symptoms, MRIs with gadolinium enhancement were obtained and assessed for the presence of recurrence of disc herniation. Forty-six (19.1%) patients were lost during follow-up, 2 of those because of death by diseases not related to disc herniation and 44 because of the change of addresses or telephone numbers.

A preoperative diagnosis of lumbar disc herniation was based on symptoms, physical examination, and MRI finding. The initial open discectomies were only performed in patients with intractable pain who had not responded to conservative treatment for at least 6 weeks. Recurrence of disc herniation was defined as symp-

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Table 1. Disease-Free Survival Rate for Lumbar Disc Herniation After Open Discectomy in Active Young Men

Variables	Standard Survival Analysis				Worst-Case Survival Analysis			
	No. Failed	No. LEFT	Survival Rate (%)*	95% CI	No. Failed	No. Left	Survival Rate (%)*	95% CI
1-yr	7	234	97.1	95.0–99.2	22	219	90.9	87.2–91.3
2-yr	10	216	95.8	93.2–98.2	43	198	82.2	77.3–87.1
3-yr	10	216	95.8	93.2–98.3	50	191	79.2	74.1–84.3
5-yr	14	187	93.8	90.6–96.9	57	158	76.3	71.0–81.6
10-yr	17	103	91.5	87.5–95.5	63	103	73.1	67.4–78.8

*Survival rate without recurrences calculated using the Kaplan-Meier method.

tom recurrence after a pain-free interval greater than 6 months in association with compatible lesions confirmed by MRI with gadolinium enhancement at the same level as that of the primary diagnosis. Patients with herniations on the contralateral side of the initially affected side and those who underwent reoperations at other hospitals under the diagnosis of recurrence at the same level were considered as recurrence.^{12,14–16}

For survival analysis, the “product-limit” method of Kaplan-Meier was used because the number of recurrences was relatively small.^{10,17,18} The basic assumption is that all patients are oper-

ated on the same day and then have different lengths of follow-up. The log-rank test was used to evaluate the effect of patient age, level of occurrence, and type of herniated disc on recurrence rate. The classification of Modic *et al*¹⁹ was applied to determine the type of disc herniation observed on preoperative MRI.

■ Results

The average age and follow-up period for 241 patients were 23.48 ± 4.83 years (range, 20–39 years) and

SURVIVAL CURVE

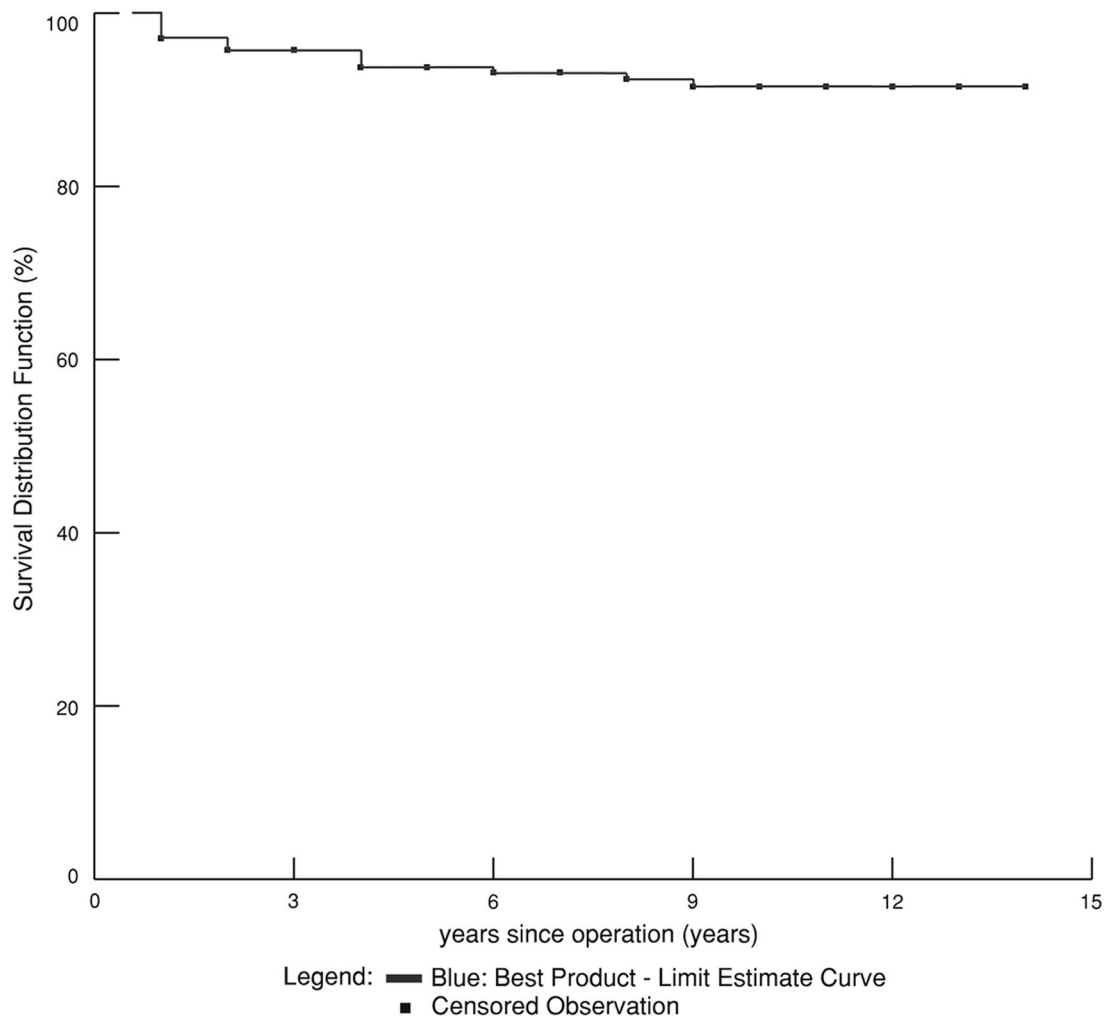


Figure 1. Disease-free survival curve of lumbar disc herniation after open discectomy in young men.

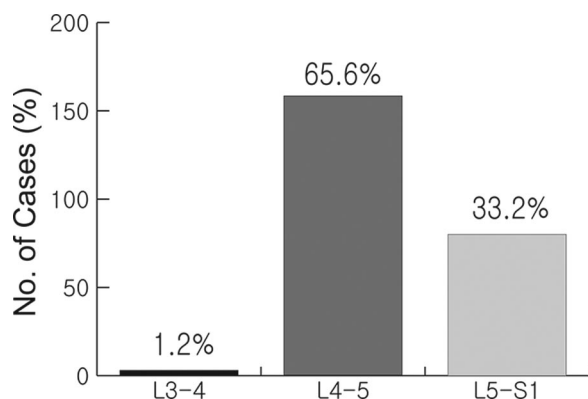


Figure 2. Level of disc herniation.

8.55 \pm 0.12 years (range, 1–14 years), respectively. A total of 17 patients were confirmed as having recurrence of disc herniation. The overall recurrence rate was 7.1% and the cumulative survival rate was 91.5% at a follow-up of 14 years (Table 1). The recurrence rate according to survival analysis (*i.e.*, the figure that is subtracted from 100% to give the cumulative survival rate) was 8.5%, which was greater than the overall recurrence rate. The average time to recurrence was 3.1 \pm 2.6 years since surgery. The annual recurrence rate was highest in the first year after surgery (2.9%) and the cumulative survival rate showed no change after 9 years as there was no recurrence after that time (Figure 1). The cumulative survival rate of the worst case.

Recurrence of disc herniation occurred in 14 (6.8%) of the 207 patients aged 20 to 29 years, and in 3 (8.8%) of the 34 patients aged 30 to 39 years. The difference between these recurrence rates was not statistically significant ($P = 0.653$).

Primary disc herniation occurred at L4 to L5 in 158 patients (65.6%), at L5 to S1 in 80 patients (33.2%), and at L3 to L4 in 3 patients (1.2%) (Figure 2). Recurrent herniation occurred at L4 to L5 in 13 patients (8.2%) and at L5 to S1 in 4 patients (5.0%). There was no recurrent disc herniation at L3 to L4 (Figure 3). The differences in recurrence rates between levels were not found to be statistically significant ($P = 0.745$).

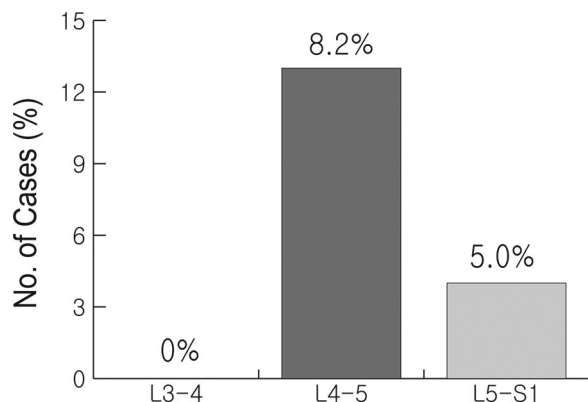


Figure 3. The distribution of recurrence levels.

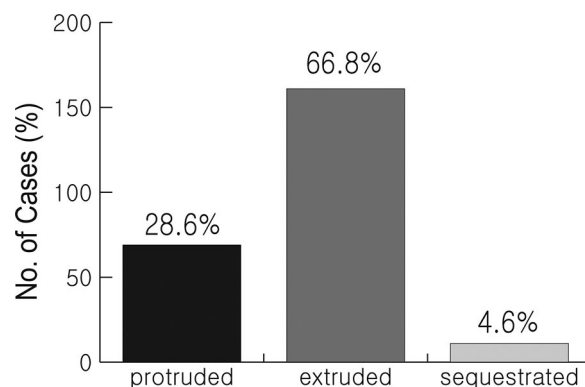


Figure 4. Type of herniated disc.

Herniated discs were classified as protruded, extruded, or sequestered based on MRI. One hundred sixty-one patients (66.8%) had extruded discs, 69 patients (28.6%) had protruded discs, and 11 patients (4.6%) had sequestered discs (Figure 4). Recurrences developed in 6 (3.7%) of the patients with extruded discs and in 11 (15.9%) of the patients with protruded discs (Figure 5). There was no recurrence in the patients with sequestered discs. The recurrence rate of disc herniation in the protruded type was significantly greater than those in the other types.

Discussion

Although the recurrence rate of lumbar disc herniation has been reported in 5% to 12% of patients after surgery, the studies differed in terms of patient populations, follow-up periods, definition of recurrence, and type of procedure.^{20–27} The authors found the overall recurrence rate was 7.1% at a mean follow-up of 8.55 years. Recurrence rate in the present study of young active men was similar to that reported in studies of the general population, even though young age and male gender are known to be risk factors for recurrence.^{14,16} Despite some studies reporting a higher incidence of recurrent herniation in young men,^{16,28,29} it seems that further prospective controlled studies are required before this observation can be considered definitive. To explain the

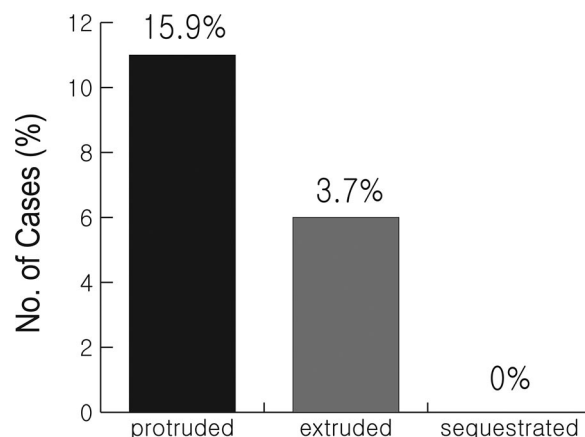


Figure 5. Distribution of recurrence according to the type of herniated disc at the time of preoperation diagnosis.

higher incidence of recurrent herniation in young men, it has been suggested that the anular incision made at primary surgery makes the operated disc more susceptible to sudden prolapse, particularly under conditions of mechanical overload experienced during sports activity or lifting,¹⁴ but we surmise that more fundamental problem is in the methodology of evaluating recurrence rate.

The definition of recurrence can affect the reported recurrence rate. Although many studies use the rate of revision as an outcome measure of lumbar discectomy,^{10,15,30} the present study defined recurrence as symptom recurrence after a pain-free interval greater than 6 months associated with compatible lesions demonstrated by MRI with gadolinium enhancement at the same level as that of the primary diagnosis. We believe that it is important to consider the recurrence of symptoms irrespective of the requirement of revision surgery.

In general, reports of longer-term follow-up show higher rates of recurrence than those reporting mean

rates.^{8,10,30} This may be because of the fact that disc pathology seems to be a dynamic condition that demonstrates various changes according to the time course rather than a static condition. Therefore, estimation of recurrence rate as a simple ratio at a specific follow-up period entails inherent limitations and makes direct comparisons between studies difficult. Survival analysis is a statistical method that can reduce errors when using long-term follow-up data. This method has also been employed to evaluate the failure evaluation of the total hip replacement arthroplasty.^{17,18} To our knowledge, this is the first study to examine the recurrence of lumbar disc herniation after open discectomy, specifically in active young men using survival analysis.

The association of recurrence rate with the type of disc herniation is still not conclusive. In a study of 2504 operations, Spangfort³¹ reported that the improvement in disc herniation after surgery was inversely proportional to the degree of extrusion; Morgan-Hough *et al*¹⁵

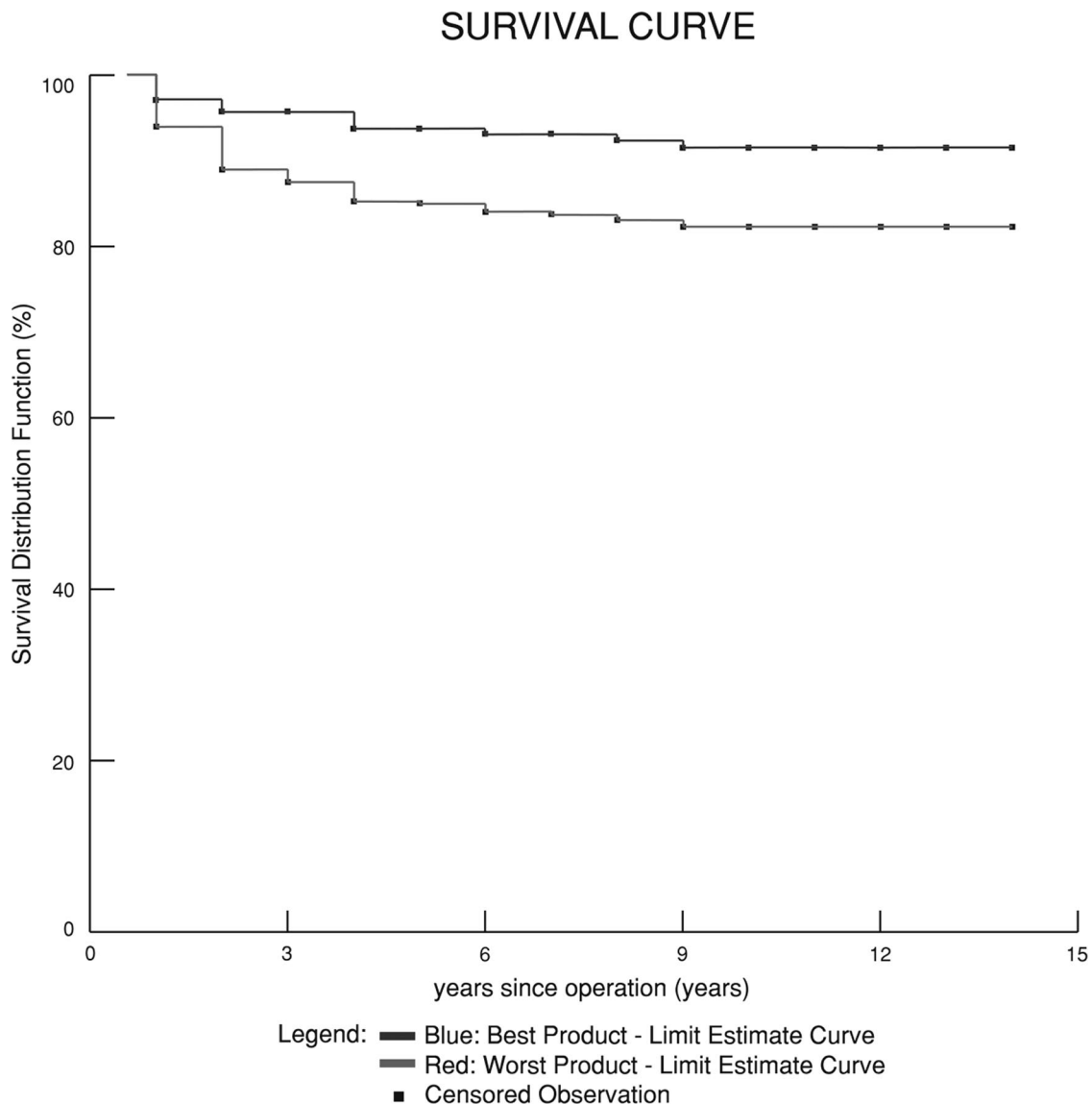


Figure 6. Standard survival curve compared with the worst-case curve, which is calculated by assuming that patients lost to follow-up had recurrent disc herniations.

reported a revision rate of 7.9% over a period of 16 years in a study of 531 patients and concluded that a contained disc protrusion was almost three times more likely to need revision surgery compared with extruded or sequestered discs. In contrast, in the study of Carragee *et al*,⁸ patients in the fragment-defect group, who had extruded fragments and massive posterior annular loss, had higher rates of reherniation and reoperation than those in other groups (fragment-fissure group, fragment-contained group, and no fragment-contained group). In this study, the recurrence rate after open discectomy was significantly higher in the protruded type than in the other types. This may be because the removal of herniated disc might not be complete in the protruded type, though Cinotti *et al*¹⁴ found no difference in the rate of recurrence associated with partial or complete discectomy. The above observations indicate surgeons must be prudent in surgical decision-making and use meticulous operative techniques to ensure disc fragments are not missed in patients with protruded discs.

Our study had several important limitations. The first limitation is that only symptomatic recurrence confirmed by MRI was used as the end point for survivorship analysis. This definition did not consider patients who had the recurrent lesion on MRI but did not have any symptom. Pain is a complex matter that involves psychosocial factors, which are likely to be more important than physical factors. The absence of symptoms does not rule out lumbar disc herniation because this condition is highly prevalent in the asymptomatic normal population.³² Of the patients who did not have any symptom, it is never known how many patients would have the true recurrence. With this mind, the survivorship data presented in the present study most likely underestimated the percentage of recurrence. However, it is impossible to obtain yearly follow-up MR images from asymptomatic patients because of economic and ethical problem and we thought the disc herniation would not be clinically important, if it was only demonstrated on MRI but did not provoke any symptom.

The greatest limitation of our study is the rate of the follow-up loss and the follow-up length. Though the survival analysis is a useful statistical technique considering the different lengths of follow-up period and the number of patients lost to follow-up, one of the most important factors to influence the recurrence rate of disc herniation is the thoroughness of follow-up.^{10,15} In the current study, the average time to recurrence was 3.1 years after surgery. Forty-eight patients were observed up less than 3.1 years. Ten of 44 patients were cases with recurrent disc herniation and other 38 patients were cases lost to follow-up. Patients lost to follow-up might fail to attend as a result of poor outcome. Therefore, in addition to standard survival analysis, we also performed the worst-case survival analysis after loss to follow-up was used as the definition of failure.³³ Although the true recurrence rate is not low as the worst-case rate, it gives an indication of how much the results would have been degraded if patients lost to

follow-up had subsequent recurrent disc herniations (Figure 6).

The present study found that the recurrence rate according to the survival analysis was greater than the overall recurrence rate at final follow-up and that the survival analysis estimate was a more accurate indicator of recurrence than the mean rate. The recurrence rate continued to rise steadily as time goes by until 9 years after surgery in our series; it was 2.8% in patients followed at 1 year, 6.2% at 5 years, and 8.5% at 9 years. The annual recurrence rate was highest in the first year after surgery and there was no recurrence after 9 years of follow-up. Whereas these observations are likely to correlate with the physical activities of the patients, more studies are necessary to establish their fundamental causes.

■ Conclusion

The recurrence rate of disc herniation increased with time after surgery. As such, survival analysis provides a more accurate estimation of true recurrence rate. The recurrence rate of disc herniation after open discectomy in active young men was found to be similar to that reported in studies of the general patient population. Recurrence rate was significantly higher for patients with protruded disc herniations compared with other herniation types.

■ Key Points

- The recurrence rate of lumbar disc herniation after open discectomy in active young men was evaluated using survival analysis.
- The overall recurrence rate was 7.1% at a mean follow-up of 8.55 years and the cumulative survival rate was 91.5% at a follow-up of 14 years.
- The recurrence rate of disc herniation increased with time after surgery and therefore survival analysis provides a more accurate estimation of true recurrence rate.
- The recurrence rate in active young men was similar to that reported for the general patient population.
- Protruded discs were more likely to show recurrence than other types of herniation.

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